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ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

Conversion of Tree-Volume Equations to the Metric System

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Presents factors for converting volume equations of the form

 $V = a + b D^2 H$ from U. S. Customary to metric units.Oxford: 516:511. Keywords: Tree volume estimates, *Pinus ponderosa*, *Pinus contorta*, *Picea engelmannii*.ROCKY MOUNTAIN FOREST AND RANGE
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Interest in and use of metric units is increasing in the United States. Foresters are beginning to wonder what familiar relationships may look like after adoption of the metric system. A convenient opportunity to look ahead is provided by cubic-foot volume equations of the form $V = a + b D^2 H$.

Changing volume equations from U. S. Customary to metric units requires three conversion factors. Exact values adopted by the National Bureau of Standards (Chisholm 1967) are:

Inches to centimeters — multiply by 2.54

Feet to meters — multiply by 0.3048

Cubic feet to cubic meters — multiply by 0.028316846592

Conversion of cubic volume equations in current use (table 1) to equations in metric units (table 2) requires three multiplications:

1. Multiply the original regression coefficient b by 0.01440 to obtain the metric coefficient b' .
2. Multiply the original intercept a by the cubic-foot-to-cubic-meters factor, above, to obtain the new intercept a' .

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3. Multiply the original $D^2 H$ limit (table 1) by 1.96644768 to obtain the equivalent limit in centimeters and meters (table 2). This step is necessary where two equations are used for a relationship because of nonlinearity over the desired range of $D^2 H$.

After these multiplications have been made, computed volumes are in cubic meters (V') instead of the original cubic feet (V).

Numerical values given in the three steps are produced from published exact values as follows:

$$2.54 \times 2.54 \times 0.3048 = 1.96644768$$

$$0.028316846592 \div 1.96644768 = 0.01440$$

As examples of the conversion from Customary to metric units, two Black Hills ponderosa pines have the following dimensions and total volumes:

8.5 inches d.b.h., 50 feet tall, 8.02 cubic feet
18.5 inches d.b.h., 90 feet tall, 74.6 cubic feet

The same trees have these dimensions and volumes in metric units:

21.6 centimeters d.b.h., 15.24 meters tall, 0.227 cubic meter
47.0 centimeters d.b.h., 27.43 meters tall, 2.112 cubic meters

Table 1.--Coefficients of tree volume equations for selected western conifers, U. S. Customary units

Species	Utilization	D ² H Limit	Intercept a	Coefficient b	Reference
Ponderosa pine, Black Hills	Total	≤ 6000	0.030288	0.002213	Myers 1964a
	Total	> 6000	-1.557103	0.002474	
	4-in. Top	≤ 6700	-1.032297	0.002297	
	4-in. Top	> 6700	-2.257724	0.002407	
Lodgepole pine, Colo., Wyo.	Total	≤ 7000	0.027967	0.002777	Myers 1964b
	Total	> 7000	3.446454	0.002332	
	4-in. Top	≤ 7000	-1.045780	0.002798	
	4-in. Top	> 7000	2.836222	0.002256	
Ponderosa blackjack, Ariz., N. Mex.	Total	≤ 6000	0.5870	0.001824	Myers 1972
	Total	> 6000	-1.091458	0.002103	
	4-in. Top	≤ 6500	-0.20550	0.001770	
	4-in. Top	> 6500	-2.061477	0.002056	
Engelmann spruce, Colo., Wyo.	Total	≤ 22500	0.06439	0.00239	Myers and Edminster 1972
	Total	> 22500	10.41663	0.00193	
	4-in. Top	≤ 27900	-0.83010	0.00232	
	4-in. Top	> 27900	13.11320	0.00182	
Ponderosa yellow pine, Ariz., N. Mex.	Total	> 5180	-0.402357	0.002302	Myers 1972
	4-in. Top	> 5180	-1.440832	0.002255	

Table 2.--Coefficients of tree volume equations for selected western conifers, metric units

Species	Utilization	D ² H Limit	Intercept a	Coefficient b
Ponderosa pine, Black Hills	Total	≤ 11800	0.0008577	0.0000319
	Total	> 11800	-0.0440922	0.0000356
	10-cm Top	≤ 13200	-0.0292314	0.0000331
	10-cm Top	> 13200	-0.0639316	0.0000347
Lodgepole pine, Colo., Wyo.	Total	≤ 13800	0.0007919	0.0000400
	Total	> 13800	0.0975927	0.0000336
	10-cm Top	≤ 13800	-0.0296132	0.0000403
	10-cm Top	> 13800	0.0803129	0.0000325
Ponderosa blackjack, Ariz., N. Mex.	Total	≤ 11800	0.0166220	0.0000263
	Total	> 11800	-0.0309066	0.0000303
	10-cm Top	≤ 12800	-0.0058191	0.0000255
	10-cm Top	> 12800	-0.0583745	0.0000296
Engelmann spruce, Colo., Wyo.	Total	≤ 44200	0.0018233	0.0000344
	Total	> 44200	0.2949661	0.0000278
	10-cm Top	≤ 54900	-0.0235058	0.0000334
	10-cm Top	> 54900	0.3713245	0.0000262
Ponderosa yellow pine, Ariz., N. Mex.	Total	> 10190	-0.0113935	0.0000331
	10-cm Top	> 10190	-0.0407998	0.0000325

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